

PRESCRIPTION INSTRUCTIONS
WEST KITSAP WAU

INSTRUCTIONS FOR FIELD VERIFICATION OF MAPPING UNITS, WATER, AND WETLANDS.

Implementation of many of the prescriptions will require field identification of mapping units. The mapped units are approximate boundaries because of the map scale and use of aerial photographs for determination of boundaries. The descriptions of mapping units should be used as a guide to locate the actual boundaries of map units in the field during the layout of proposed timber harvest and road construction activities. More detailed descriptions of map units may be found in the assessment reports.

State water type maps have been found to underestimate the occurrence of fish-bearing streams and other water types in the watershed. It is important to accurately complete the water and wetland sections of the forest practice applications. This will require accurate mapping locations and verifications of all water and wetland types associated with the proposed forest practice activity. (For water type information see WAC 222-16-030 and for wetland typing information see WAC 222-16-035.)

The field verification and identification of map unit boundaries can be done by a forester or other resource managers, water typing verification must be completed by a qualified person. Qualified means a person with at least a Bachelor of Science degree in natural resources and 12 credit hours in fish science course work, plus experience in the use of back pack electroshockers and electrofishing.

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 12
WEST KITSAP WAU**

WAU: West Kitsap

Resource Sensitivity Number: Map ARS-3; Unit 12

Description: Riparian zones along Geomorphic Unit 1, lower mainstem alluvial flood plain and along segment bb4 in Geomorphic Unit 5, moderate gradient till plain streams (originally delineated in Geomorphic Unit Map E-2 and Channel Segment Map E-1).

Situation Sentence:

Potential large woody debris (LWD) recruitment (from bank erosion, windthrow, and deadfall), has been and could be reduced from past tree removal within all channel segments within Geomorphic Unit 1, reducing the formation of scour structures which contribute to the development of pools, gravel retention structures and fish cover habitat.

Trigger Mechanism:

Removal of trees of a size and type sufficient to function as LWD in a channel of this type.

Rule Call:

Prevent or avoid

Management Objective:

Maintain and/or manage riparian zones which provide high ($\geq 85\%$) potential key piece LWD recruitment of old growth coniferous stands and/or 95% potential recruitment of mature stands ($\geq 24"$ DBH).

Prescriptions:

Select one of the following options:

Option A:

1. Locate outer edge of the channel migration zone (CMZ) as indicated on map ARS 3. No harvest is allowed within the CMZ.
2. From the outer edge of the CMZ maintain a 100 foot HD (horizontal distance) riparian management zone (RMZ). Within this 100 foot RMZ the following apply:
 - a. 30 foot HD no cut buffer from the edge of the CMZ.

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 12
WEST KITSAP WAU**

- b. Leave 60 of the largest conifer trees per acre 24 inch diameter breast height (DBH) or larger within the outer 70 feet of RMZ. If there are not 60 conifer trees per acre ≥ 24 in. DBH, utilize the following table (Table 2b) to determine the conifer leave tree spacing following harvest.

To use Table 2b you must determine the minimum size class of the 60 largest conifer trees per acre and the number of trees per acre greater than 24" DBH within the managed zone of the RMZ. Using this information you can determine the appropriate conifer leave tree spacing.

For example, if your 60 largest conifer trees per acre had a minimum size of 10"DBH and there were 30 conifer trees per acre greater than 24" DBH then the stand spacing after harvest must be 15 feet or less for the largest available conifer trees.

Table 2b

Minimum size class of 60 largest conifer trees per acre within the outer 70' of the RMZ.	Number of conifer trees ≥ 24 " DBH/ac. within outer 70' of RMZ		
	0-19 conifer	20-39 conifer	40-59 conifer
≥ 18 " DBH	less than 20' tree spacing (100/ac)	less than 25' tree spacing (70/ac)	less than 25' tree spacing (70/ac)
≥ 12 " DBH	less than 15' tree spacing (190/ac)	less than 20' tree spacing (100/ac)	less than 25' tree spacing (70/ac)
≥ 6 " DBH	less than 15' tree spacing (190/ac)	less than 15' tree spacing (190/ac)	less than 20' tree spacing (100/ac)

- c. Minimize disturbance to understory vegetation and soils. Use of mobile ground harvest machinery within RMZ prohibited.
- d. Partial harvest of 33% of the volume or less is acceptable in hardwood dominated stands provided all conifer trees, all trees providing shade and all

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 12
WEST KITSAP WAU**

trees leaning toward the stream channel are left undisturbed. Care will be exercised in tree selection and logging systems lay out to avoid excessive damage to residual trees during yarding operations. Minimize damage to understory conifer during treatment. For each hardwood tree removed within the RMZ, 3 conifer must be replanted within the next planting season. Species recommended for replanting include western red cedar, sitka spruce, and/or western hemlock depending upon on site conditions, or an alternative reforestation plan shall be provided to the DNR for approval to assure the successful regeneration of conifer trees.

Option B:

1. Locate outer edge of the channel migration zone (CMZ) as indicated on map ARS-3. No harvest is allowed within the CMZ.
2. The RMZ shall be a 100 foot HD no cut buffer measured from the edge of the CMZ.

Justification for Prescriptions:

A channel migration zone is an area adjacent to an active channel. Within the CMZ the channel has a high potential to shift rapidly or avulse over the course of a rotation or beyond. The intent is to provide adequate protection and source of LWD, shade, and other inputs to a stream which may change course rapidly. If the channel is no longer where riparian protection was established, the objective of providing a long-term source of LWD is not met. Therefore, trees within the CMZ were not included in leave tree counts.

Due to the large size (and stream power) these channels, large woody debris (≥ 24 inches DBH) is needed for channel stability and pool formation. While recruitment of much of the wood occurs via bank erosion (Appendix E: Channel Assessment Report), an important source for recruitment of large conifers are the drier, CMZ-adjacent hillslopes. The prescriptions therefore require leaving all trees in the CMZ and the first 30 feet of the RMZ, and 60 of the largest conifer trees per acre ≥ 24 " DBH within the 30-100 feet zone of the RMZ. A conifer leave tree spacing chart was developed to give the applicant guidance in tree spacing which enables harvest without jeopardizing future LWD recruitment.

Approximately 95% of in-channel LWD pieces associated with mature conifer stands and 85% of in-channel LWD pieces associated with old growth conifer in western Washington and Oregon originated within 100 feet of the streambank (McDade et al. 1990). The first 100 feet is an area of direct influence and is critically important for supplying functional woody debris.

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 12
WEST KITSAP WAU**

Beyond 100 feet the likelihood of LWD recruitment significantly decreases. Potentially augmenting the percent of recruitable LWD within GMU #1 are the harvest restrictions associated with mass wasting and shade prescriptions. The extensive CMZ frequently associated with these channels makes the likelihood of LWD recruitment from distances greater than 100 feet HD from the RMZ very small.

Given a target density of 50 trees per acre for mature to late-seral conditions, providing 60 trees per acre accounts for mortality and windthrow over a rotation. While 70 trees per acre have been used within the Lester WAU prescriptions to account for expected losses from mortality and windthrow, windthrow is thought to be less significant within the West Kitsap WAU, thereby justifying a slightly lower initial tree density.

The need for very large, stable debris in the stream channel is recognized, and this material is a by-product only of old stands. By requiring that all conifers be retained within the inner no harvest zone and the remainder of the RMZ be managed for increased growth of conifers, the prescriptions recognize the need for large, stable debris decades into the future. The possible short term loss of smaller stems that may be removed from the managed zone is considered to be a positive trade off for the increased growth expected from remaining trees. Thinning in the outer 70 feet of the RMZ will accelerate crown and diameter growth, thus enhancing the RMZ's potential to provide future functional LWD.

Providing a partial cut option for hardwood dominated stands provides an opportunity to manage and promote conifer establishment within the outer 70 foot of hardwood dominated RMZ's. Over time, this should promote conifer dominated stands without compromising short term recruitment levels.

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 13
WEST KITSAP WAU**

WAU: **West Kitsap**

Resource Sensitivity Number: Map ARS 3; Unit 13

Description: Riparian zone along geomorphic unit 2, low gradient mainstem ravines (Originally delineated on Geomorphic Unit Map E-2).

Situation Sentence:

Potential large woody debris (LWD) recruitment (from bank erosion, windthrow, and deadfall), has been or could be reduced from past tree removal along all channel segments within Geomorphic Unit 2, reducing the formation of scour structures which contribute to the development of pools, the retention of gravel, energy, dissipation, and providing fish cover habitat.

Trigger Mechanism:

Removal of trees of a size and type sufficient to function as LWD in a channel of this type.

Rule Call:

Prevent or avoid

Management Objective:

Maintain and/or manage riparian zones which provide high ($\geq 85\%$) potential key piece LWD recruitment of old growth coniferous stands and/or 95% of mature stands ($\geq 24"$ DBH).

Prescriptions:

Select one of the following options:

Option A:

1. Identify the outer edge of the channel migration zone (CMZ) or edge of the ordinary high water mark (OHWM) using the attached "CMZ Description and Delineation Procedure" (Appendix E). No harvest is allowed within the CMZ.
2. From the outer edge of the CMZ or OHWM, which ever is greater, maintain a 100 foot HD (horizontal distance) riparian management zone (RMZ). Within this 100 foot RMZ the following apply:
 - a. 30 foot HD no cut buffer from the edge of the CMZ.

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 13
WEST KITSAP WAU**

- b. Leave 60 of the largest conifer trees per acre 24 inch DBH or larger within the outer 70 foot edge of the RMZ. If there are not 60 conifer trees per acre ≥ 24 " DBH, utilize the following table (Table 2b) to determine the conifer leave tree spacing.

To use Table 2b you must determine the minimum size class of the 60 largest conifer trees per acre and the number of trees per acre greater than 24" DBH within the managed zone of the RMZ. Using this information you can determine the appropriate conifer leave tree spacing for your stand.

For example, if your 60 largest conifer trees per acre had a minimum size of 10"DBH and there were 30 conifer trees per acre greater than 24"DBH then the stand spacing after harvest must be 15 feet or less for the largest available conifer trees.

Table 2b

Minimum size class of 60 largest conifer trees per acre within the outer 70' of the RMZ.	Number of conifer trees ≥ 24 " DBH/ac. within outer 70' of RMZ		
	0-19 conifer	20-39 conifer	40-59 conifer
≥ 18 " DBH	less than 20' tree spacing (100/ac)	less than 25' tree spacing (70/ac)	less than 25' tree spacing (70/ac)
≥ 12 " DBH	less than 15' tree spacing (190/ac)	less than 20' tree spacing (100/ac)	less than 25' tree spacing (70/ac)
≥ 6 " DBH	less than 15' tree spacing (190/ac)	less than 15' tree spacing (190/ac)	less than 20' tree spacing (100/ac)

- c. Minimize disturbance to understory vegetation and soils. Use of mobile ground harvest machinery within RMZ is prohibited.
- d. Partial harvest of 33% of the volume or less is acceptable in hardwood dominated stands provided that all conifer trees, all trees providing shade and all trees leaning toward the channel are left undisturbed. Care will be exercised in tree selection and logging systems lay out to avoid excessive damage to residual trees during yarding operations. Minimize damage to

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 13
WEST KITSAP WAU**

understory conifer during treatment. For each hardwood tree removed within the RMZ, 3 conifer must be replanted within the next planting season. Species recommended for replanting include western red cedar, sitka spruce, and/or western hemlock, depending on site conditions or an alternative reforestation plan shall be provided to the DNR for approval to assure the successful regeneration of conifer trees.

Option B (where landowner does not wish to delineate the CMZ):

1. Identify a 150 foot horizontal distance RMZ from the ordinary high water mark (OHWM). Within this 150 foot RMZ the following apply:
 - a. 80 foot no cut buffer from the OHWM (includes a 50 foot CMZ plus 30 foot RMZ buffer)
 - b. Leave 60 of the largest conifer trees per acre within the outer 70 feet of the RMZ 24 in. DBH or larger. If there are not 60 trees per acre \geq 24 in. DBH, utilize Table 2b in option A to determine the conifer leave tree spacing.
 - c. Minimize disturbance to understory vegetation and soils. Use of mobile ground harvest machinery within RMZ is prohibited.
 - d. Removal of deciduous trees is allowed within the outer 70 feet of the RMZ. All trees providing shade and/or that are leaning toward the channel shall be left. Care will be exercised in tree selection and logging systems lay out to avoid excessive damage to residual trees during yarding operations. Minimize damage to understory conifer during treatment. For each hardwood tree removed within the RMZ, 3 conifer must be replanted within the next planting season. Species recommended for replanting include western red cedar, sitka spruce, and/or western hemlock, depending on site conditions or an alternative reforestation plan shall be provided to the DNR for approval assure the successful regeneration of conifer trees.

Option C (where landowner does not wish to delineate CMZ or harvest within the RMZ (120 feet HD):

1. Maintain a 150 foot HD no harvest riparian management zone from the ordinary high water mark (OHWM).

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 13
WEST KITSAP WAU**

Justification for Prescriptions:

A channel migration zone is an area adjacent to an active channel. Within the CMZ the channel has a high potential to shift rapidly or avulse over the course of a rotation or beyond. The intent is to provide adequate protection and source of LWD, shade, and other inputs to a stream which may change course rapidly. If the channel is no longer where riparian protection was established, the objective of providing a long-term source of LWD is not met. Therefore, trees within the CMZ were not included in leave tree counts.

No map delineating the CMZ is provided given its patchy distribution. Channel surveys along two 1,000 foot reaches in GU 2 on Big Anderson Creek indicate CMZ widths average between 10 and 42 ft on each side of the ordinary high water mark (OHWM)(Fenton, Maki, and Maxim, May 17 1995). Average CMZ widths for other GU 2 channels are thought to be around 20 feet (P. Bahls, Pers. Communication). Since the CMZ is a potentially difficult feature to delineate, Option B enables the landowner to manage their stands without specific CMZ determinations. This option will assure future LWD recruitment and may reduce the number of potential problems associated with CMZ delineation.

Approximately 95% of potential LWD recruited within mature conifer stands and 85% of potential LWD recruited within old growth conifer in Western Washington and Oregon originates within 100 feet of the streambank (McDade et al. 1990). The first 100 feet is an area of potential influence and is critically important for supplying functional woody debris. Beyond 100 feet, the likelihood of LWD recruitment significantly decreases. Potentially augmenting the percent of recruitable LWD within GU #2 are the harvest restrictions associated with mass wasting and shade prescriptions.

Extent of LWD contributed by bank erosion is quite variable, even within a given geomorphic unit. While McDade's (1990) study found 11% was contributed by bank erosion in first through third order streams, between 52%-60% was contributed in alluvial channels in Alaska (Murphy and Koski 1989). In addition, surveys of two 1,000 foot segments within geomorphic unit 2 (Big Anderson Creek) suggest bank erosion contributed 44%-63% of the LWD functional (Fenton, Maki, and Maxim, May 1995). If the percent of LWD contributed by bank erosion in GU #2 is significantly larger than that found by McDade, then the distances associated with various recruitment percentages would be less.

The need for very large, stable debris in the stream channel is recognized, and this material is a by-product only of old stands. By requiring that all conifers be retained within the inner no harvest zone and the remainder of the RMZ be managed for increased growth of conifers, the

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 13
WEST KITSAP WAU**

prescriptions recognize the need for large, stable debris decades into the future. The possible short term loss of smaller stems that may be removed from the managed zone is considered to be a positive trade off for the increased growth expected from remaining trees. Thinning in the outer 70 feet of the RMZ per Table 2b will accelerate crown and diameter growth, thus enhancing the RMZ's potential to provide future functional LWD. The CMZ frequently associated with these channels is roughly 20 feet, making the likelihood of LWD recruitment from distances beyond the outer edge of the RMZ (100 feet from the CMZ edge) very small.

A partial cut option for hardwood dominated stands provides an opportunity to manage and promote conifer establishment within the outer 70 foot of hardwood dominated RMZ's.

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 14
WEST KITSAP WAU**

WAU: **West Kitsap**

Resource Sensitivity Number: Map ARS-3; Unit 14

Description: Riparian zone along Geomorphic Unit 3, moderate gradient ravine tributaries; along Geomorphic Unit 4a, large wood-step channels; and along Geomorphic Unit 5, moderate gradient till plain streams. Segment bb4 (Big Beef Creek immediately above Lake Symmington) in Geomorphic Unit 5 is included in Unit 12 on Map ARS-3. Unit 4a is physically described in the channel assessment report.

Situation Sentence:

Potential large woody debris (LWD) recruitment (from windthrow, dead fall, and hillslope movement) has been or could be reduced from the past tree removal in all segments within Geomorphic Units 3, 4a, which may reducing the formation of step-pool structures which contribute to channel stability, sediment storage, and energy dissipation.

Trigger Mechanism:

Removal of trees of a size and type sufficient to function as LWD in a channel of this type.

Rule Call:

Prevent or avoid

Management Objective:

For fish bearing streams maintain and/or manage riparian zones which provide a high potential for current and long-term recruitment of key pieces of coniferous LWD.

For non-fish bearing streams prevent the loss of LWD recruitment by retaining trees which promote channel stability, sediment storage and energy dissipation.

Prescriptions:

For fish bearing channels or channels that are presumed to be fish bearing per Forest Practice Rules (Type 1,2,3, waters), refer to SECTION 1. For verified non-fish-bearing channels (Type 4 and 5 waters): Use SECTION 2 for Geomorphic Unit 3 & 4a and SECTION 3 for channels in Geomorphic Unit 5. Contact the WDNr South Puget Sound Region Office for the current forest practice rules regarding water typing definitions and verification procedures prior to implementation of prescriptions.

SECTION 1:

Those segments which are fish-bearing or meet the physical criteria for fish-bearing streams (Type 1-3) require one of the following two options:

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 14
WEST KITSAP WAU**

Option A:

1. Identify on the ground the outer edge of the ordinary high water mark (OHWM). The OHWM is the exposed unvegetated bank adjacent to the channel.
2. For fish-bearing streams in geomorphic unit 3 and 4a from the edge of the OHWM establish a 100-foot HD (horizontal distance) riparian management zone (RMZ). Within this 100 foot HD RMZ the following apply:
 - a. 30 foot HD no cut buffer from the edge of the channel.
 - b. Minimize disturbance to understory vegetation and soils . No mobile ground harvest machinery is allowed within the RMZ.
 - c. Leave the 60 largest conifer trees \geq 20 inch DBH per acre within outer 70 feet of the RMZ. If there are not 60 large conifer trees \geq 20 inch DBH per acre leave the 100 largest conifer trees per acre.
 - d. Removal of deciduous trees is allowed when they occur at distances greater than 30 feet HD from the OHWM. Leave all trees providing shade and all trees leaning toward the channel. Care will be exercised in tree selection and logging systems lay out to avoid excessive damage to residual trees during yarding operations. Minimize damage to understory conifer during treatment.
 - e. For each deciduous tree removed within the RMZ, 3 conifer must be replanted within the next planting season. Species recommended for replanting include western red cedar, sitka spruce, and/or western hemlock, depending on site conditions, or an alternative reforestation plan shall be provided to the DNR for approval to ensure the successful regeneration of conifer trees.
3. For fish-bearing streams in geomorphic unit 5 establish a 75 foot HD (horizontal distance) riparian management zone (RMZ). Within this 75 foot HD RMZ the following apply:
 - a. 30 foot HD no cut buffer from the edge of the channel.

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 14
WEST KITSAP WAU**

- b. Minimize disturbance to understory vegetation and soils . All types of mobile ground harvest machinery use is prohibited within RMZ
- c. Leave the 60 largest conifer trees \geq 12 inch DBH per acre within outer 45 feet of the RMZ. If there are not 60 large conifer trees \geq 12 inch DBH per acre leave the 100 largest conifer trees per acre.
- d. Removal of deciduous trees is allowed when they occur at distances greater than 30 feet HD from the OHWM. Leave all trees providing shade and all trees leaning toward the channel. Care will be exercised in tree selection and logging systems lay out to avoid excessive damage to residual trees during yarding operations. Minimize damage to understory conifer during treatment.
- e. For each deciduous tree removed within the RMZ, 3 conifer must be replanted within the next planting season. Species recommended for replanting include western red cedar, sitka spruce, and/or western hemlock, depending on site conditions, or an alternative reforestation plan shall be provided to the DNR for approval to ensure the successful regeneration of conifer trees.

Option B:

- 1. Identify the outer edge of the ordinary high water mark (OHWM). The OHWM is the exposed unvegetated bank adjacent to the channel.
- 2. For fish-bearing streams in geomorphic unit 3 and 4a maintain a 100 foot HD no harvest riparian management zone from the OHWM.
- 3. For fish-bearing streams in geomorphic unit 5 maintain a 75 foot HD no harvest riparian management zone from the OHWM.

SECTION 2: Verified to be non-fish bearing channels within Geomorphic Unit 3 and 4a.

Option A:

- 1. Maintain a 60 foot horizontal distance (HD) no harvest RMZ from the OHWM.

**PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 14
WEST KITSAP WAU**

Option B: (for # 1 and # 2 below)

Determine the average % side slope within 60 feet of the OHWM adjacent to the stream segment (a stream segment must be 100 lineal feet or more of stream channel).

1. For stream segments that have an average side slope of 30% or less and show no evidence of channel incision below tree rooting depth (typically 3 feet deep), provide a 25 foot no cut and no disturbance buffer from the OHWM.
2. For stream segments that have an average side slope greater than 30% provide the following:
 - a. Establish a RMZ boundary either by measuring 60 feet HD from the OHWM or by measuring 25 feet from the first break in slope above the OHWM, which ever is less (a break in slope must be at least a 20% reduction in side slope for 25 feet).
 - b. Provide a 25 foot HD no cut buffer from the edge of the channel.
 - c. Leave 50 of the largest available trees, well distributed per 1000 feet along each side of stream within the established RMZ in "a" above. Trees within the 25 foot no cut buffer may be included in the tree count.
 - d. Minimize disturbance to understory vegetation and soils within the RMZ.
All use of mobile ground harvest machinery within the RMZ is prohibited.

SECTION 3: Verified to be non-fish bearing channels within Geomorphic Unit 5.

1. Provide a 25 foot HD no cut buffer from edge of channel.

Landowners are encouraged to use these type 4 & 5 streams as areas to meet their wildlife and green recruitment trees requirements per forest practice rules.

Justification for Prescriptions:

Key pieces in fish-bearing GU 3-4a channels. Managing for near and long term recruitment of key pieces is important for maintaining fish habitat and will facilitate channel stability and the retention of smaller potentially functional pieces of LWD

PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 14
WEST KITSAP WAU

within the stream channel (Bisson et al 1987). Key pieces of LWD are defined as those critical to maintaining fish habitat which are large enough to resist transport during all but extreme (10-year or greater recurrence interval) peak flows (WFPB 1995). Surveys in Big Beef Subbasin-segment BB44 (Point No Point Treaty Council letter to DNR in 1996) found that 20 inch diameter (key) pieces were necessary for step formation and significant sediment storage. While smaller functional LWD having a minimum diameter of 12 inches was observed to function in many GU 3 streams (W. Kitsap Channel Assessment Report (page 19)), the intent of managing for >20 inch key pieces is to ensure future recruitment of wood necessary for maintaining step-pools critical for fish habitat as well as channel stability. Reductions in key pieces could result in channel incision, potentially destabilizing banks and adjacent hillslopes. In addition, the rapid rate of decay of deciduous trees within stream channels necessitates managing for conifer key piece recruitment.

Key piece source distances for GU 3-4a channels. The degree to which tree removal within an RMZ reduces future loadings of functional wood is a matter of speculation, though three studies have been conducted which evaluate the cumulative percent LWD recruited from within a given distance from the stream edge. McDade (et al 1990) found that approximately 95% of in-channel LWD pieces associated with mature conifer stands and 85% of in-channel LWD pieces associated with old growth conifer stands in western Washington and Oregon originated within 100 feet of the streambank. Assuming that mature stands result in average stand diameters of approximately 20" DBH, potential selective harvest of the smaller trees within the outer 70 feet of the RMZ will likely result in slightly more than a 5% reduction in key piece recruitment potential. It is recognized that removal of some potentially recruitable trees may occur within the RMZ, though this is assumed to be small given the 60 leave tree requirement.

Key piece source distances for fish-bearing GU 5 channels. Within most GU 5 channels, key pieces of LWD are assumed to be those with a minimum diameter of 12 inches (the largest GU 5 channel segments, namely Big Beef Creek above Lake Symmington, are included in prescription unit 12). Though we are also

PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 14
WEST KITSAP WAU

assuming that McDade's (1990) findings are also relevant in this GU, using their mature conifer curve is overly conservative to the degree that mature stands would be taller and larger than those capable of achieving the management objective, namely supplying 12 inch or greater conifers. It follows that potential source distances will be less since 20 inch diameter trees will likely be somewhat taller, and therefore have greater recruitment potential, than 12 inch trees at the same distance. Given the above, a 75 foot RMZ width will ensure protection comparable to those steeper, downstream fish bearing waters.

Though McDade's (1990) research does not provide a means for fully evaluating LWD source distances under this prescription, a recent research project by a UW senior (McKinley 1997) does provide insight into how LWD source distances in 50-80 year old stands vary by debris diameter class. McKinley surveyed 17 sites in the Granite Falls area in the western Cascades with average source slopes of 12.6% to 76.1%, channel gradients between 4.9% and 58.6%, and average bankfull widths from 6.5 ft to 34.4 ft. For channels similar to those in GU 3 and 4a (and to a lesser degree GU 5), approximately 85% of LWD pieces >11 inches in diameter (measured mid-stream) originated within 25 feet (horizontal distance), and 95% within 50 ft, of the channel. As this information has not been peer reviewed, however, a conservative buffer of 75 feet was employed. McDade's (mature conifer) and McKinley's (total debris pieces >4 inches in diameter and 4 ft in length) source distance curves predict 85% and 97% of LWD key pieces will be left for potential future recruitment.

Type 4 and 5 waters: GU 3 & 4a with >30% sideslopes.

Comments pertaining to functional wood size made in the previous section also apply here. While pool formation necessary for fish habitat is not an issue, maintaining longterm sources of LWD necessary for channel bed and bank stability as well as short-term sediment storage are very important. While prescriptions for these streams are designed to prevent adverse impacts to downstream resources, in many cases these channels are flanked by steep (>60%) sideslopes and will therefore be included within much larger no-cut or selective cut areas per prescriptions 1 and 4.

PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 14
WEST KITSAP WAU

It is assumed that providing a 25 foot no cut buffer will ensure bank stability and may also serve to dissipate energy of debris flows which have periodically entered these channels. Half a tree crown diameter, approximately 20-25 feet, is an estimate of the extent to which root systems effect soil stability (Burroughs & Thomas 1997). In addition, the leave tree requirement (50 of the largest available trees per 1000 feet >20 inch DBH) within the 60 foot RMZ ensures an average stem density of 1 tree every 15 feet along each side of the channel. This tree density should prevent the loss of LWD needed for sediment storage and local channel gradient control.

Type 4 and 5 waters: GU 3 & 4a (with <30% sideslopes) and GU 5. GU 3 and 4a channels with <30% sideslopes are assumed to be both infrequent and small (<4 feet wide) which flow over short, gently sloping (<20%) benches above the valley floor. A lack of incision into these benches suggests that stream power (a function of discharge and slope) necessary to transport and scour bed alluvium is reduced relative to steeper channels. The stability of the bed and banks in these channels is largely maintained by roots and small debris provided by a 25 foot zone. Where channels have incised below local tree rooting depths (approximately 3 feet), the ability of roots to maintain bed and bank stability is reduced. In these instances, managing for LWD which is capable of controlling rates of incision and providing local gradient controls, such as is outlined for >30% sideslopes, is necessary.

The headwater channels within GU 5 are low to moderate gradient (1-4%) streams flowing over consolidated glacial till. Segments generally connect large wetlands (with little transport capacity) on the till plain with steeper ravine tributaries (GU 3 & 4a) downstream. Similar to low gradient, GU 3 and 4a ravine channels, small woody debris, understory vegetation and tree roots combine with LWD to maintain stable banks, dissipate stream energy and store sediments.

As noted earlier, the extent to which reduced wood loadings would result in downstream degradation is a matter of speculation. McKinley's (1997) source distance data does suggest, however,

PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 14
WEST KITSAP WAU

that approximately 75% originated within 25 feet (horizontal distance) of the channel. As most riparian corridors within these GU's are second growth stands and functional wood can be provided by these stands, it follows that 25 foot no cut buffers will likely provide adequate near and long-term wood loadings. McKinley also found that where source (channel adjacent) slopes are less than 25%, a larger percentage of wood was recruited for source distances less than 25 feet. In particular, the cumulative percent of LWD contributed from within 15 feet is 60 and 70% where source slopes are >25% and less than 25%, respectively. This data also suggest the 85% of all hardwoods are recruited from within 25 ft horizontal distance of the channel edge, which is similar to McDade's findings of approximately 75% hardwood recruitment.

Where past management practices have led to significant channel incision into consolidated glacial till it is likely that these activities included entry into, and disturbance of, the channel bed and banks (in addition to harvest within the RMZ) and resulted in significant in-stream disturbance which jeopardized hydraulic roughness provided by intact streambanks. In segment BB49 (Big Beef Creek Subbasin), incision of up to 10 feet has occurred, likely as a result of both past removal of riparian vegetation as well as more recent urbanization which may be conveying storm-flow rapidly (via numerous ditches) to the channel (Appendix C: Hydrologic Change Assessment). Given the relative paucity of observations of incision in these segments relative to the number which have historically experienced nearly complete removal of riparian trees, however, it appears that channel degradation is not associated solely with reductions in LWD.

References:

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PRESCRIPTION: LARGE WOODY DEBRIS ARS-3; UNIT 14
WEST KITSAP WAU

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Burroughs, E.R., Jr., and Thomas, B.R. 1977. Declining root strength in Douglas-fir after felling as a factor of slope stability. Res. Pap. INT-190. Ogden, UT: U.S. Dept of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, 27 p.

McDade, M.H., F.J. Swanson, W.A. McKee, J.F. Franklin, and J. VanSickle. 1990. Source distances for coarse woody debris entering small streams in western Oregon and Washington. Can. J. For. Res., 20:326-330.

McKinley, J. 1997. Large woody debris recruitment source distances for western Washington cascade streams. Unpublished senior research project for Univ. of Washington, College of Forest Resources, Seattle, WA. 35 p.

Washington Forest Practices Board (WFPB). 1995. Board Manual: Standard Methodology for Conducting Watershed Analysis, Version 3.0, November 1995. WA Dept of Natural Resources, Forest Practices Division, Olympia, WA 98504.

**PRESCRIPTION: CANOPY CLOSURE/STREAM TEMPERATURE ARS-4; UNIT 15
WEST KITSAP WAU**

WAU: West Kitsap

Resource Sensitivity Number: MAP ARS-4; Prescription Unit 15

Description: Thomas, Big Anderson, Harding, Stavis, Seabeck, Big Beef, Little Anderson-Type 1-3 Waters plus 1000 feet of Type 4 streams that contribute 20% or more of the flow to a fishbearing stream.

Situation Sentence:

Increased inputs of solar radiation from past and potential future canopy/shade removal in Thomas, Big Anderson, Harding, Stavis, Seabeck, Big Beef and Little Anderson Creeks associated with timber harvest along both sides of the stream likely has resulted in, or will result in, increased water temperatures, potentially impacting summer rearing salmonids.

Triggering Mechanism:

Timber and vegetation removal from past timber harvesting.

Rule Call for Management Prescription (from causal mechanism report):

Prevent/Avoid

Management Objections:

Manage riparian areas to provide adequate shade to meet state water quality standards.

Prescription:

No tree removal within 100 feet of the ordinary high water mark if the reach is currently below shade required by the Forest Practice Board Manual. If the reach meets shade requirements, individual trees not providing shade can be removed, provided the applicant provides a shade analysis to the DNR for approval. The densiometer is the recognized tool for evaluating shade, though an alternative method may be used provided it can be shown to be reliable at identifying shade trees.

Justification:

The first 100 feet from the stream provides the most effective shade to the stream. This prescription recognizes the future potential shade that could be provided by trees which are currently too small, or are located on the outer boundary of the RMZ, but over time and with increased growth, could provide shade.

The spherical densiometer, which is the TFW approved tool for quantifying shade, is assumed to be reliable at identifying shade trees. It is also assumed that prohibiting the removal of shade within 100 feet will result in stream temperatures which meet state water quality standards.

**PRESCRIPTION: TYPE 4 WATERS ARS-4; UNIT 16
WEST KITSAP WAU**

WAU: West Kitsap

Resource Sensitivity Number: MAP ARS-4; Prescription Unit 16

Description: Type 4 streams in Geomorphic Units 3-5 that have not been field verified by a TFW agency representative or qualified fishery technician. Unverified stream reaches includes all those not verified in the PNPTC Water Typing Project (Bahls and Erath, 1994), nor verified since this prescription took effect.

Situation Statement:

Inaccurate water type maps used to regulate riparian protection in unverified Type 4 streams of less than 12% gradient in Geomorphic Units 1-5 provide inadequate protection to riparian functions (LWD, shade) resulting in loss of riparian functions in mis-typed streams damaging fish habitat and water quality.

Triggering Mechanism(s):

Removal of riparian buffers from fish-bearing streams due to timber sale planning and regulation using non-verified DNR water Type maps for Type 4 streams of less than 12% gradient (as estimated using topographic map or field measurements) results in reducing riparian functions, fish habitat and water quality.

Rule Call:

Prevent/Avoid

Prescription: (NOTE: Emergency stream typing rules currently supersede the following prescriptions. Contact DNR for the latest rules for stream typing.)

- 1.. Those Forest Practice Applications containing a Type 4 stream require the following:
 - A. Determine if the Type 4 stream in the proposed FPA has less than a 12 percent gradient based on estimation from topographic map or field measurements described in the Washington Forest Practice Handbook.
2. Those Forest Practice Applications containing a Type 4 stream that has less than a 12% gradient require the following:
 - A. Determination of stream type made in the field by trained TFW cooperator or qualified fishery technician based on fish presence and/or physical criteria as defined in the Washington Forest Practice regulations and handbook.

**PRESCRIPTION: TYPE 4 WATERS ARS-4; UNIT 16
WEST KITSAP WAU**

- B. Written information on results of stream type verification provided in the comment section (No. 29) of the Forest Practice Application. Information will include who did verification, methods, and results. A water type change form completed by the initiator of the FPA must be included with the FPA for any change in stream type.

Justification for prescription:

The Washington Water Type maps were found to greatly under-estimate the occurrence of fish-bearing streams and other stream types in this watershed (Point No Point Treaty Council study Stream Typing Error in Washington Water Type Maps for Watersheds of Hood Canal and the Southwest Olympic Peninsula, Bahls and Ereth, 1994). Based on the survey results, it is expected that 53 percent of the unverified type 4 stream miles are actually fish-bearing type 3 streams. The prescription team has narrowed the criteria for the CMR to include only unverified Type 4 streams of less than 20% gradient because these streams have a higher likelihood of being fish-bearing than steeper gradient streams. Most streams in Little Anderson, Seabeck, Harding and Big Anderson sub-basins have been field verified and maps showing recent field verifications are available upon request. However, water types in other sub-basins have not been field verified. Prior to 1993 no systematic stream type verification was conducted and all Type 4 and smaller stream segments not upgraded in the PNPTC study should be considered potentially inaccurate until field verified.

While this prescription helps identify and remedy the most likely stream typing errors, the landowner maintains responsibility for accurate stream type determination for all streams, regardless of whether the stream is included in this prescription or not.

**PRESCRIPTION: TYPE 5 & 9 WATERS ARS-4; UNIT 17
WEST KITSAP WAU**

WAU: West Kitsap

RESOURCE SENSITIVITY NUMBER: MAP ARS-4; Prescription Unit 17

Description: Type 5 and 9 streams in Geomorphic Units 3-5 with more than one-quarter mile of stream shown on Water Type Map upstream of the proposed Forest Practice Application and that has not been field verified by a TFW agency representative or qualified fishery technician. Unverified stream reaches includes all those not verified in the PNPTC Water Typing Project (Bahls and Ereth, 1994), nor verified since this prescription took effect.

Situation Statement:

Inaccurate water type maps used to regulate riparian protection in unverified Type 5 and 9 streams in Geomorphic Units 1-5 with more than one-quarter mile of stream shown on Water Type Map upstream of proposed Forest Practice Application provide inadequate protection to riparian functions (LWD recruitment, bank stabilization, sediment filtration) resulting in loss of riparian functions in mis-typed streams and downstream fish-bearing waters damaging water quality and downstream fish habitat.

Triggering Mechanism(s):

Removal of riparian zones or riparian leave areas from fish-bearing streams due to timber sale planning and regulation using non-verified DNR water Type maps for Type 5 and 9 streams with more than one-quarter mile of stream shown on the Water Type Map upstream of the FPA would reduce riparian functions, water quality and downstream fish habitat.

Rule Call:

Prevent/Avoid

Prescription: (NOTE: Emergency stream typing rules currently supersede the following prescriptions. Contact DNR for the latest rules for stream typing.)

1. Those Forest Practice Applications containing a Type 5 or 9 stream require the following:
 - A. Determine if the Type 5 or 9 stream has more than one-quarter mile of stream length shown on the Water Type Map located upstream of the most downstream point of the stream on the proposed FPA.

**PRESCRIPTION: TYPE 5 & 9 WATERS ARS-4; UNIT 17
WEST KITSAP WAU**

2. Those Forest Practice Applications containing a Type 5 or 9 stream that is shown on the Water Type Map extending more than one-quarter mile upstream and is considered "un-verified" by DNR require the following:
 - A. Determination of stream type made in the field by trained TFW cooperator or qualified fishery technician based on fish presence and/or physical criteria as defined in the Washington Forest Practice regulations and handbook.
 - B. Written information on results of stream type verification provided in the comment section (No. 29) of the Forest Practice Application. Information will include who did verification, methods, and results. A water type change form completed by the initiator of the FPA must be included with the FPA for any change in stream type.

Justification for prescription:

The Washington Water Type maps were found to greatly under-estimate the occurrence of fish-bearing streams and other stream types in this watershed (Point No Point Treaty Council study Stream Typing Error in Washington Water Type Maps for Watersheds of Hood Canal and the Southwest Olympic Peninsula, Bahls and Ereth, 1994). Based on the results, it is expected that about 44 percent of the actual Type 4 streams are incorrectly identified as Type 5 or 9 streams or not shown on the maps. The prescription team has narrowed the criteria for the CMR to include only unverified Type 5 and 9 streams with more than one-quarter mile of stream length shown on the Water Type Map because these streams are considered the most likely to be incorrect due to the greater upstream drainage area as represented by stream length. Most streams in Little Anderson, Seabeck, Harding and Big Anderson sub-basins have been field verified and maps showing recent field verifications are available upon request. However, water types in other sub-basins have not been field verified. Prior to 1993 no systematic stream type verification was conducted and all Type 4 and smaller stream segments not upgraded in the PNPTC study should be considered potentially inaccurate until field verified.

While this prescription helps identify and remedy the most likely stream typing errors, the landowner maintains responsibility for accurate stream type determination for all streams, regardless of whether the stream is included in this prescription or not.

**PRESCRIPTION: MASS WASTING ARS-1; UNIT 1 & 4
WEST KITSAP WAU**

WAU: West Kitsap

Resource Sensitivity Number: MAP ARS-1; Prescription Unit 1 & 4

Description: Mass Wasting Map Unit 2 & 5 - Steep (60% or greater) slopes underlain by glacial sediments having a potential for sediment delivery to a stream channel or shoreline.
(Refer to Mass Wasting Unit 2 & 5, Map A-2)

Situation Sentence for the Area (from causal mechanism report):

Coarse and fine sediments from past (and potential future) shallow-rapid landslides and deep-seated slumps in Mass Wasting Map Unit 2 & 5 associated with road construction and timber harvest in valley side slopes or coast slopes greater than 31 degrees (60%) formed by fluvial or wave excavation of glacially-associated sediments potentially delivering sediment to fish-bearing streams and shellfish beds have caused and could cause localized channel aggradation and widening, in-filling of pools, and substrate fining in Geomorphic Units 1, 2, and 3, thereby reducing summer and winter rearing habitat, limiting spawning success, and reducing adult holding pools.

Triggering Mechanism (from causal mechanism report):

Roads and timber harvest related to soil type, see Causal Mechanism Report Summary.

Rule Call for Management Prescription (from causal mechanism report):

Prevent and Avoid

Management Objective:

Reduce inputs of coarse and fine sediments by reducing potential for shallow rapid landslides and deep-seated slumps along Geomorphic Units 1, 2, and 3.

Prescriptions:

Determine percent ground slope within the forest practice (harvest unit or road location) and verify map unit type and boundaries:

- A. Standard rules apply to slopes less than 60% which show no signs of instability.
- B. Standard rules also apply to all slopes which have a low delivery potential. Low delivery potential occurs where 60% or greater slopes change to less than 36% for at least 500 feet (slope distance) or when 36% to 60% slopes change to less than 36% slopes for at least 150 feet. The channel migration zone (CMZ), as defined in

PRESCRIPTION: MASS WASTING ARS-1; UNIT 1 & 4 WEST KITSAP WAU

appendix C, shall not be included in the runout distance assessment. The delivery rating is high and prescriptions in Section C (below) apply where run out distances are less than those listed above.

- C. No harvest is to occur on slopes greater than 70%. Slopes greater than or equal to 60% or slopes less than 60% which show signs of instability and which have a high delivery potential require a site evaluation by an experienced and trained specialist.

Signs of instability include:

- convergent or hollow topography
- landslide scar morphology
- emergent groundwater/perched groundwater conditions
- hydric vegetation
- streambank erosion at the toe of slope
- evidence of accelerated soil creep
- tension cracks in the soil
- jackstrawed or pistol-butted trees
- other local factors that have significant association with slope instability

Specialists must be trained/educated in soil science, geology, or geomorphology and have a minimum of 5 years of field experience. The specialist must delineate and mark in the field the following substrate types so that the appropriate prescriptions may be applied:

Unconsolidated sand and gravels

- *No Road construction or reconstruction.
- *Road located outside this soil type must be designed so drainage is not directed on slopes greater than or equal to 60%.
- *No Harvest within head scarps or inner gorges.
- *On dry, planar slopes between 60% and 70%, partial harvest is permitted provided that a tree density of at least 1 mature tree (10" dbh or greater) every 20 feet is maintained.
- *Full Suspension of logs required.

Competent Till

- *Fully engineer roads, with designated waste areas and no side cast construction. Roads require full-bench and end-haul construction techniques.
- *No harvest on slopes > 60%.
- *Full Suspension of logs required.

**PRESCRIPTION: MASS WASTING ARS-1; UNIT 1 & 4
WEST KITSAP WAU**

Fine Grained Deposit (commonly found along incised stream channels or along cut banks)

- *No road construction or reconstruction within 100 feet (slope distance).
- *No harvest within 50 feet (slope distance).

Unconsolidated sediment overlaying fine grained deposits

- *No road construction or reconstruction over, or road drainage discharge onto, these soils.
- *No harvest within 50 feet (slope distance) of any contact elevation (as potentially indicated by springs or convergent topography with wet soil indicators).
- *Full suspension of logs required.
- *Reforest harvest unit within first planting season following harvest at a density of 400 stems per acre. Provide proof of seedling availability (IE. purchase order).
- *No harvest on slopes >60%.

Justification for Prescriptions:

Prescriptions were stratified by substrate type within Mass Wasting Map Units (MWMU's) 2 and 5 given the variability in trigger mechanisms. The four substrate types within these MWMU's cannot be accurately mapped from aerial photos and require on-site delineation. While delivery determinations can be made accurately by foresters and private landowners, qualified specialists are necessary for accurate delineation of substrate types listed in section C.

The angles of hillslopes within Mass Wasting Units 2 and 5 which may be considered stable are primarily determined by the likelihood of soil saturation. When dry, the substrates maintain a stable angle of 30 to 40° (58 to 84%). When saturated, however, stable angles are only about 15° (27%) (Appendix A: West Kitsap Mass Wasting Report). Areas immediately above impermeable layers (such as till and lacustrine clays) are likely to experience soil saturation during winter storms and are therefore very sensitive to reductions in root strength following harvest. It is assumed, however, that areas of soil saturation will not extend further than 50 feet upslope from these contacts and that soils above this 50 foot elevation band which are less than 60% will remain stable following tree removal.

With respect to "Unconsolidated sands and gravels," the West Kitsap Mass Wasting Assessment found numerous landslides associated with roads, headscarps and convergent topography while none were recorded on planar slopes subjected only to timber harvest. Though 60% or greater slopes in this material are exceeding the angle of repose, it is assumed

**PRESCRIPTION: MASS WASTING ARS-1; UNIT 1 & 4
WEST KITSAP WAU**

that the combination of lateral root strength and good drainage promote stability. To ensure stability on marginally stable slopes, namely those between 60%-70%, while also providing for some tree removal, a partial harvest is prescribed. A partial harvest which maintains a stem spacing of one 10-inch dbh, or greater, tree every 20 feet is assumed to maintain adequate lateral root strength and will likely be comparable to a 33% thinning (by basal area) modeled by Krogstaad (1995). Krogstaad's model predicts only slight reductions in lateral root strength and minor increases in slope instability under that scenario. On slopes less than 60%, intrinsic soil shear strength is sufficient to maintain stability of the overlying soil (Appendix A: Mass Wasting Assessment Report).

MWMU 5 differs from MWMU 2 only with respect to likely delivery potential. As with MWMU 2 (Rx Unit 1), however, all slopes 60% or greater as well as those which have signs of instability (pistol butted trees, deep cracks perpendicular to the slope, relict scarps...) require making site-specific delivery determinations using the preceding guidelines.

Full log suspension is required to minimize the likelihood of disturbance to stumps and remaining trees and to prevent the formation of trenches running parallel to the slope which could channel water, potentially resulting in gully formation and significant surface erosion and/or hillslope destabilization.

Delivery criteria, which were used in the Tolt Mass Wasting prescriptions, stem from work done by Benda and Cundy (1990) and Coho and Burges (1991).

References:

Benda, L. and T.W. Cundy. 1990. Predicting deposition of debris flows in mountain channels, Canadian Geotechnical Journal, no. 27, p. 409-417.

Coho, C. and S.J. Burges. 1991. Analysis of initiation mechanisms of dam-break floods in managed forests. Timber/Fish/Wildlife Report, Dept of Natural Resources, Olympia, Washington.

Krogstaad, F. 1995. A physiology and ecology based model of lateral root reinforcement of unstable hillslopes, MS thesis, Univ. of Washington, 44pp.

**PRESCRIPTION: MASS WASTING ARS-1; UNIT 2
WEST KITSAP WAU**

WAU: West Kitsap

Resource Sensitivity Number: MAP ARS-1; Prescription Unit 2

Description: Mass Wasting Map Unit #3, Deep seated landslide complexes (Refer to Wasting Unit 3, Map A-2).

Situation Sentence for the Area (from causal mechanism report):

Coarse and fine sediment from past and potential future shallow-rapid landslides in Mass Wasting Map Unit 3 (MWMU #3) associated with road construction in deep-seated landslide complexes have/could cause localized channel aggradation and widening, filling pools, and substrate fining in Geomorphic Units 1, 2, and 3, reducing summer and winter rearing habitat and limiting spawning success.

Triggering Mechanism (from causal mechanism report):

Road construction on existing deep-seated landslides, or drainage from roads discharged onto existing deep-seated landslides, can increase landslide movement rates. Cut slopes into the toe of such slopes can initiate or reactivate deep-seated landsliding.

The head scarps of these landslide complexes cut through unconsolidated outwash deposits, and over steepened slopes (>60%) in the headscarps are naturally unstable. Exposed soils in these areas are slow to revegetate and are subject to surface erosion.

Rule Call for Management Prescription (from causal mechanism report):

Prevent and Avoid

Management Objective:

Prevent and avoid delivery of sediment from shallow-rapid and deep-seated landslides to stream channels in geomorphic Units 1, 2, and 3.

Prescriptions:

- No road construction or reconstruction within map unit.
- Do not concentrate drainage of water onto this map unit from roads located outside this map unit.
- No harvest on or within 50 feet of headscarps. Head scarps are typically concave landforms on steep slopes (60% or more) in the outwash sands.

**PRESCRIPTION: MASS WASTING ARS-1; UNIT 2
WEST KITSAP WAU**

Justification for Prescriptions:

Road construction in the head scarps and on the toes of landslide debris have triggered shallow-rapid landslides which have delivered fine sediment to fish-bearing channels.

Landslides on toes have also delivered coarse sediment to these channels.

Clearcut harvest activity could reduce root strength in head scarps (slopes >60%), resulting in shallow-rapid landslides. Surface erosion of landslide scarps also have a high likelihood of delivering fine sediment to stream channels. While road drainage discharge was noted as a potential trigger of shallow-rapid failures on the surface of MWMU 3 as well as potential reinitiation of movement of deep-seated failures, timber harvest in potential groundwater recharge areas was not noted as a trigger mechanism of deep-seated landslides. While all deep-seated landslides appear to be dormant within West Kitsap WAU and have not been reactivated by historic or recent management activities, shallow-rapid failures in headscarps and on toes have frequently occurred.

Headscarps are generally steep (> 70%), bare, wall-like cliffs at the back of a hollow or hillslope depression. A 50 foot no cut strip on the periphery of headscarps is intended to provide stability by maintaining lateral root strength approximately equivalent to 2 tree widths thereby serving as a lateral anchor from these to more stable slopes.

Landslide toes are typically consolidated, oversteepened slopes exceeding 60% verging on active channels.

**PRESCRIPTION: MASS WASTING ARS-1; UNIT 3
WEST KITSAP WAU**

WAU: **West Kitsap**

Resource Sensitivity Number: MAP ARS-1; Prescription Unit 3

Description: Mass Wasting Map Unit (MWMU) #4, landslide debris derived from unconsolidated sand and gravel deposits and fine grained sediments.
(Refer to Mass Wasting Unit 4, Map A-2)

Situation Sentence for the Area (from casual mechanism report):

Coarse and fine sediment from shallow rapid landslides in MWMU #4 associated with road construction and timber harvest in toe slopes of the debris piles at the base of the deep seated landslide complexes can cause localized channel aggradation and widening, in-filling of pools, and substrate fining in Geomorphic Units #1, 2 and 3, thereby reducing summer and winter rearing habitat, limiting spawning success and reducing adult holding pools.

Triggering Mechanism (from casual mechanism report):

Roads- excavations into the slopes, such as a cut slope for a road, could cause landslides.

Harvest- root strength is a factor in stability of soils on slopes greater than 60%.

Rule Call for Management Prescriptions (from casual mechanism report):

Prevent and avoid

Management Objective:

To prevent coarse and fine sediment from entering streams.

Prescriptions:

- No Road Construction.
- No Harvest.

JUSTIFICATION:

Mass wasting Unit #4 is located on the over-steepened toe of landslide debris above fish bearing streams. Any disturbance in this area will result in a high probability of a slope failure with direct and immediate delivery to the streams. Avoiding road construction, road reconstruction and harvest will prevent both fine and coarse sediment entry to the stream from forest management activity.

**PRESCRIPTION: ROAD EROSION ARS-2; UNIT 5
SHORELINE SUB-BASIN
WEST KITSAP WAU**

WAU: West Kitsap

Resource Sensitivity Number: MAP ARS-2; Prescription Unit 5

Description: REMU 1, Shorelines sub-basin
(Refer to Road Erosion Unit 1, Map B-4)

Situation Sentence for the Area (from causal mechanism report):

Fine sediment from past and present surface erosion from roads in Road Erosion Map Unit 1 (REMU 1 = shorelines sub-basin) due to traffic and direct delivery of sediment to streams causes excess turbidity and sedimentation of marine intertidal habitat in Hood Canal waters, degrading water quality and reducing quality of marine intertidal habitat.

Triggering Mechanism (from causal mechanism report):

Traffic on roads with inadequate surfacing material and maintenance. Road usage, particularly log haul during wet weather, can result in a much higher input delivery level of fine sediment.

Rule Call for Management Prescription (from causal mechanism report):

Prevent or Avoid

Management Objective:

Prevent the fine sediments from roads from entry streams.

Prescriptions:

1. Prior to approval of a forest practice all active and inactive roads associated with the forest practice require a detailed road maintenance plan (refer to Appendix B, Road Maintenance Guidelines) detailing how delivery of sediment will be prevented.
2. If sediment is delivered to a stream from active log haul traffic stop delivery of sediment or stop haul traffic until problem is corrected. (Statement reflects standard rules.)
3. Avoid road construction or reconstruction where they would be capable of direct sediment delivery to streams.
4. Avoid reconstruction of old unused roads that have re-vegetated or stabilized.

PRESCRIPTION: ROAD EROSION ARS-2; UNIT 5
SHORELINE SUB-BASIN
WEST KITSAP WAU

5. Landowners are encouraged to abandon roads, especially those roads along stream channels. Abandonment shall be in accordance with WAC 222-24-050 (5) and the abandonment section of the Road Maintenance Guidelines (ref. Appendix B).
6. If road construction or reconstruction is unavoidable (where the other option would lead to greater damage to public resources) a fully engineered road plan (refer to Appendix C) that shows in detail how delivery of sediment will be prevented is required. The plan must be approved by the DNR.

Justification for Prescriptions:

Stopping log haul or correcting sediment entry into streams during wet weather conditions will reduce the delivery of sediment to streams from roads in REMU 1, Shorelines sub-basin.

Implementation of additional sediment abatement opportunities as outlined in a road construction and maintenance plan will help prevent sediment delivery to the streams.

The prescription team recommends that Kitsap County consider these prescriptions in their evaluation of existing and proposed non-forest use roads.

**PRESCRIPTION: ROAD EROSION ARS-2; UNIT 6
STAVIS, BOYCE, & LITTLE ANDERSON SUB-BASIN
WEST KITSAP WAU**

WAU: West Kitsap

Resource Sensitivity Number: MAP ARS-2; Prescription Unit 6

Description: REMU 1, Stavis, Boyce and Little Anderson sub-basins
(Refer to Road Erosion Unit 1, Map B-4)

Situation Sentence (from casual mechanism report):

Fine sediment from past and present surface erosion from roads in Road Erosion Map Unit 1 (REMU #1), in Stavis, Boyce and Little Anderson sub basins, due to traffic and direct delivery of road sediment to streams. Sediment infiltrates gravel, fills pools and causes excess turbulence in Geomorphic Units 1 & 2 affecting spawning, rearing and migration of Coho.

Trigger Mechanism (from casual mechanism report):

Traffic on roads with inadequate surfacing material and maintenance. Road usage, particularly log haul during wet weather, can result in a much higher delivery input level of fine sediment.

Rule Call (from casual mechanism report):

Prevent or avoid

Management Objectives:

Prevent the fine sediments from roads from entry streams.

Prescriptions:

1. Prior to approval of a forest practice, all active and inactive roads associated with the forest practice require a detailed road maintenance plan (ref. Appendix B, Road Maintenance Guidelines), detailing how delivery of sediment will be prevented.
2. If sediment is delivered to a stream from active log haul traffic, remediate or stop haul traffic until problem is corrected. (Statement reflects standard rules.)
3. Avoid road construction or reconstruction where they would be capable of direct sediment delivery to streams.
4. Avoid reconstruction of old unused roads that have revegetated or stabilized.
5. Landowners are encouraged to abandon roads, especially those roads along stream channels. Abandonment shall be in accordance with WAC222-24-050 (5) and the abandonment section of Appendix B (Road Maintenance Guidelines).

**PRESCRIPTION: ROAD EROSION ARS-2; UNIT 6
STAVIS, BOYCE, & LITTLE ANDERSON SUB-BASIN
WEST KITSAP WAU**

6. If road construction or reconstruction is unavoidable (where the other option would lead to greater damage to public resources) a fully engineered road plan (refer to Appendix C) that shows in detail how delivery of sediment will be prevented is required. The plan must be approved by the DNR.

Justification for Prescriptions:

Stopping log haul or correcting sediment entry into streams during wet weather conditions will reduce the delivery of sediment to streams from roads in REMU 1.

Implementation of additional sediment abatement opportunities as outlined in a road construction and maintenance plan will help prevent sediment delivery to the streams.

The prescription team recommends that Kitsap County consider these prescriptions in their evaluation of existing and proposed non-forest use roads.

**PRESCRIPTION: ROAD EROSION ARS-2; UNIT 7
BIG BEEF, SEABECK, & BIG ANDERSON
WEST KITSAP WAU**

WAU: **West Kitsap**

Resource Sensitivity Number: MAP ARS -2; Prescription Unit 7

Description: REMU 2, Big Beef, Seabeck, and Big Anderson
(Refer to Road Erosion Unit 2, Map B-4)

Situation Sentence for the Area (from causal mechanism report):

Fine sediment from past and potential future surface erosion from roads in Road Erosion Map Unit 2 (Map B-4, REMU 2) in Big Beef, Seabeck, and Big Anderson sub-basins, due to traffic and direct delivery of sediment to streams, infiltrates gravel, fills pools, and causes excess turbidity in Geomorphic Units 1 and 5, limiting spawning, rearing, and migration habitat of coho, summer and fall chum, chinook, steelhead, and cutthroat.

Triggering Mechanism (from causal mechanism report):

Traffic on roads with inadequate surfacing material and maintenance. Road usage, particularly log haul during wet weather, can result in a much delivery level of fine sediment.

Rule Call for Management Prescription (from causal mechanism report):

Prevent and Avoid

Management Objective:

Prevent and avoid delivery of road generated sediments into stream channels in Geomorphic Unit 1 and 5.

Prescriptions:

1. If sedimentation to flowing streams occurs from active truck traffic, remediate or discontinue all haul traffic until problem is corrected. (Statement reflects standard rules.)
2. Avoid road construction within channels of Geomorphic Unit 1 and 5. (For location of GMUs refer to Map ARS-3.)
3. If road construction or reconstruction is unavoidable (where the other option would lead to greater damage to public resources) a fully engineered road plan (refer to Appendix C) that shows in detail how delivery of sediment will be prevented is required. The plan must be approved by the DNR.

**PRESCRIPTION: ROAD EROSION ARS-2; UNIT 7
BIG BEEF, SEABECK, & BIG ANDERSON
WEST KITSAP WAU**

4. Prior to approval of a forest practice, all active and inactive roads associated with the forest practice require a detailed road maintenance plan (ref. to Appendix B, Road Maintenance Guidelines) detailing how delivery of sediment will be prevented.
5. Landowners are encouraged to abandon roads, especially those roads along stream channels. Abandonment shall be in accordance with WAC 222-24-050 (5) and the abandonment section of the Road Maintenance Guidelines (ref. Appendix # B.)

Justification for Prescriptions:

Modifying direct entry drainage patterns and restricting wet weather log haul will minimize potential impacts.

**PRESCRIPTION: ROAD EROSION ARS-2; UNIT 8
HARDING & THOMAS SUB-BASINS
WEST KITSAP WAU**

WAU: **West Kitsap**

Resource Sensitivity Number: MAP ARS-2; Prescription Unit 8

Description: REMU 2, Harding and Thomas sub-basins

Situation Sentence for the Area (from causal mechanism report):

Fine sediment from past and potential future surface erosion from roads in Road Erosion Map Unit 2 (REMU 2) in Harding and Thomas sub basins, due to traffic and direct delivery of road sediment to streams, infiltrates gravel, fills pools, in Geomorphic Unit 2 (Map E-2), affecting spawning and rearing habitat of coho and cutthroat.

Triggering Mechanism (from causal mechanism report):

Traffic on roads with inadequate surfacing material and maintenance. Road usage, particularly log haul during wet weather, can result in a much higher input delivery level of fine sediment.

Rule Call for Management Prescription (from causal mechanism report):

Prevent and Avoid.

Management Objective:

Prevent and avoid delivery of road generated sediments into stream channel Geomorphic Unit 2.

Prescriptions:

1. If sedimentation to flowing streams occurs from active truck traffic, stop delivery of sediment or stop all haul traffic until problem is corrected. (Statement reflects standard rules.)
2. If road construction or reconstruction is unavoidable (where the other option would lead to greater damage to public resources) a fully engineered road plan (refer to Appendix C) that shows in detail how delivery of sediment will be prevented is required. The plan must be approved by the DNR.
3. Prior to approval of a forest practice all active and inactive roads associated with the forest practice require a detailed road maintenance plan (refer to Appendix B, Road Maintenance Guidelines), detailing how delivery of sediment will be prevented.

**PRESCRIPTION: ROAD EROSION ARS-2; UNIT 8
HARDING & THOMAS SUB-BASINS
WEST KITSAP WAU**

4. Landowners are encouraged to abandon roads, especially those roads along streams and where shown on the Roads Hazard Map. Abandonment shall be in accordance with WAC 222-24-050 (5) and the abandonment section of Appendix B, Road Maintenance Guidelines.

Justification for Prescriptions:

Modifying direct entry drainage patterns and restricting wet weather log haul will minimize potential impacts.

**PRESCRIPTION: ROAD EROSION ARS-2; UNIT 9
WEST KITSAP WAU**

WAU: **West Kitsap**

Resource Sensitivity Number: MAP ARS-2; Prescription Unit 9

Description: REMU 4, all streams and swales leading from uplands to major streams.

Situation Sentence for the Area (from causal mechanism report):

Fine and coarse sediment from past and potential future surface erosion from roads built along streams in Road Erosion Map Unit 4 (REMU 4) due to road construction and use and direct delivery of road sediment to streams, causes localized channel aggradation and widening, infiltrates gravel, fills pools, and causes excess turbidity in Geomorphic Units 1, 2, and 3, affecting spawning, rearing, and migration habitat of coho, chum, steelhead, and cutthroat.

Triggering Mechanism (from causal mechanism report):

Road construction and road use on roads built in close proximity to streams, especially the steeper streams in Geomorphic Unit 3. Roads built down ridges in this unit are not necessarily a problem.

Rule Call for Management Prescription (from causal mechanism report):

Prevent and Avoid

Management Objective:

Prevent and avoid delivery of road-generated sediments into stream channel Geomorphic Units 1, 2, and 3.

Prescriptions:

1. Avoid new road construction paralleling swales and stream channels.
2. Avoid reconstruction of old, unused roads that have re-vegetated and stabilized.
3. If road construction or reconstruction is unavoidable (where the other option would lead to greater damage to public resources) a fully engineered road plan (refer to Appendix C) that shows in detail how delivery of sediment will be prevented is required. The plan must be approved by the DNR.
4. Prior to approval of a forest practice, all active and inactive roads associated with the forest practice require a detailed road maintenance plan (ref. to Appendix B, Road Maintenance Guidelines) detailing how delivery of sediment will be prevented.

**PRESCRIPTION: SURFACE EROSION ARS-2; UNIT 9
WEST KITSAP WAU**

5. Landowners are encouraged to abandon all roads, especially those roads along swales and stream channels. Abandonment shall be in accordance with WAC 222-24-050 (5) and the abandonment section of Appendix B.

Justification for Prescriptions:

Avoiding the construction of roads in this unit will prevent delivery of sediment to the channels from roads.

Implementation of additional sediment abatement opportunities as outlined in a road construction and maintenance plan will help reduce sediment delivery to the streams.

The prescription team recommends that Kitsap County consider these prescriptions in their evaluation of existing and proposed non-forest use roads.

**PRESCRIPTION: SURFACE EROSION ARS-2; UNIT 10
WEST KITSAP WAU**

WAU: **West Kitsap**

Resource Sensitivity Number: MAP ARS-2; Prescription Unit 10

Description: For slopes greater than 35%, the area of resource sensitivity is 100 feet from ordinary high water mark. For slopes equal to or less than 35%, the area of resource sensitivity is 50 feet from ordinary high water mark.

Situation Sentence for the Area (from causal mechanism report):

Fine sediment from past and potential future surface erosion from roads in Surface Erosion Map Unit 1 (SEMU 1) due to soil disturbance near streams infiltrating gravel and causing excessive turbidity in Geomorphic Units 1, 2, and 5, limiting spawning, rearing, and migration habitat of chum, coho, steelhead, and trout.

Triggering Mechanism (from causal mechanism report):

- * soil disturbance that disrupts the organic litter layer and exposes mineral soil to rain splash over significant areas;
- * soil disturbance that compacts the soil, causing water to flow over the surface of a significant area, instead of infiltrating into the soil
- * directing surface water onto, over, or against the soil in an amount that cannot infiltrate - such as from the mouth of a culvert or run-off from impervious surfaces.

Rule Call for Management Prescription (from causal mechanism report):

Prevent or Avoid

Field Observations:

*See causal mechanism report.

Management Objective:

Prevent and avoid the delivery of fine sediment from surface erosion due to soil disturbance from entering streams.

Prescriptions:

Avoid soil disturbance in SEMU 1. Use the above description to identify and verify the prescription unit boundary.

For Ground Based Equipment Operation the Following Apply:

1. No equipment within 50 feet HD of OHWM on slopes \leq 35 percent.

**PRESCRIPTION: SURFACE EROSION ARS-2; UNIT 10
WEST KITSAP WAU**

2. Delineate equipment exclusion area or designate skid trails from landing to terminus adjacent to SEMU 1. (A skid trail is defined as any excavation or three passes with a machine.)
3. Water bars shall be installed at 100 foot intervals or at 10 foot elevation change, whichever is most frequent.
4. No equipment on slopes > 35 percent.
5. Fell and yard away from all streams.
6. Disturbed soil in SEMU 1 shall be treated by water barring, grass seeding and mulching, placing slash over exposed soil or other approved method. This shall occur concurrently with yarding.

For Cable System Operations the Following Apply:

1. Avoid soil disturbance.
2. Cable systems required on slopes > 35 percent.
3. Where practical, full suspension is required.
4. If full suspension is not possible:
 - A. Fell and yard away.
 - B. Any disturbed bare soil shall be treated with erosion control methods daily to prevent erosion. One end suspension shall be required.

Justification For Prescriptions:

Where sideslopes are 35% or less along the stream, a 50 foot distance of undisturbed litter layer can buffer uphill soil disturbance. On slopes greater than 35% a 100 foot buffer of undisturbed litter is needed. These distances were based on limited sampling in the WAU. The soils tend to have a high infiltration rate, reducing the distance that water will flow over most of the slopes.

**PRESCRIPTION: SURFACE EROSION ARS-2; UNIT 11
WEST KITSAP WAU**

WAU: **West Kitsap**

Resource Sensitivity Number: MAP ARS-2; Prescription Unit 11

Description: This unit is on steep slopes (>65%) above SEMU 1 that deliver to streams and Hood Canal.

Situation Sentence for the Area (from causal mechanism report):

Fine sediment from past and potential future surface erosion in Surface Erosion Map Unit 2 (SEMU 2) from soil disturbance on highly erodible soils that has and can deliver to streams, infiltrate spawning gravel, and cause excessive turbidity in streams in Geomorphic Units 1 and 2, limiting spawning, rearing, and migration habitat of summer and fall chum, coho, steelhead, and cutthroat.

Triggering Mechanism (from causal mechanism report):

- * Soil disturbance that exposes mineral soil, especially where the exposures would direct flow of water and sediment toward stream (like blind lead corridors or skid trails that run down the slope and deliver sediment into SEMU 1 and the stream).
- * Soil disturbance that compacts soil, reducing infiltration, delivering significant increased water and/or sediment to SEMU 1 and the stream.
- * Directing surface water or drainage from impermeable surfaces onto, over, or against the soil in an amount that cannot infiltrate.

Rule Call for Management Prescription (from causal mechanism report):

Prevent and avoid.

Field Observations:

See Causal Mechanism Report Summary

Management Objective:

Prevent and avoid the delivery of fine sediment from surface erosion due to soil disturbance from entering streams.

**PRESCRIPTION: WATER SUPPLY/PUBLIC WORKS ARS-4; UNIT 18
WEST KITSAP WAU**

WAU: West Kitsap

Resource Sensitivity Number: MAP ARS-4; Prescription Unit 18

(Refer to Mass Wasting Unit Map A-2 & Surface Erosion Map B-2)

Situation Sentence for the Area (From casual mechanism report):

Increases in coarse and fine sediment from recent and potential future mass wasting and erosion in Mass Wasting Unit 2 and Surface Erosion Map Unit 1 due to increased road construction and residential development activity are causing severe aggradation of the channel and chronic obstruction of the 72" circular RCP culvert on Little Anderson Creek at Anderson Landing Road resulting in increased risk of damage to the overlying road fill with subsequent damage to spawning habitat for chum, coho, steelhead, and cutthroat.

Triggering Mechanism (from casual mechanism report):

Sediment sources include road related mass failure and erosion from residential development upstream. Total obstruction of the culvert may result in impoundment of storm runoff, saturation of the road prism, and possible catastrophic failure of the road grade.

Rule Call for Management Prescription (from casual mechanism report):

Prevent or Avoid

Prescription:

Resource agencies, tribes, and other interested parties will meet with Kitsap County to discuss the assessment report and recommendations for actions to address non-forestry impacts to public works and water supply.

Justification:

This site has been identified as a site for sediment aggradation and blockages with the potential to severely reduce migration and spawning habitats for coho, chum, steelhead, and cutthroat and potentially cause the culvert and road fill on Little Anderson Road to fail during storm events. Field surveys in 1994 documented sediment aggradation of up to four feet for a distance of over 1000 feet above the culvert inlet. Sediment sources are attributable to mass wasting events and erosion in the headwaters of Little Anderson Creek. Problems with the site have increased since culvert installation in the 1950's with urbanization of the watershed.

As lead agency Kitsap County has the authority to deal with land use actions affecting the hydrologic regime in Little Anderson Creek sub-basin. Interested parties will assist in the development of specific recommendations.

**PRESCRIPTION: WATER SUPPLY/PUBLIC WORKS ARS-4; UNIT 19
WEST KITSAP WAU**

WAU: West Kitsap

Resource Sensitivity Number: MAP ARS-4; Prescription Unit 19

Situation Sentence for the Area (From casual mechanism report):

Increases in peak flows from recent and potential future increases in overland flow in areas upstream of the affected culvert due to increased road construction and residential development activity increases the frequency of peak flows greater than the design capacity of the 72" circular RCP culvert on Little Anderson Creek at Anderson Landing Road resulting in increased risk of damage to the overlying road fill with subsequent damage to spawning habitat for chum, coho, steelhead, and cutthroat.

Triggering Mechanism (from casual mechanism report):

Increased urbanization for the Little Anderson Creek Hydrologic Analysis unit has and will result in increases in the magnitude of peak flow events due to more effective routing of storm runoff over impervious areas (see Section C3 in the Hydrology Module Report for more detailed information).

Rule Call for Management Prescription (from casual mechanism report):

Prevent or Avoid

Prescription:

Resource agencies, tribes, and other interested parties will meet with Kitsap County to discuss the resources assessment and recommendations to address non-forestry impacts to public works and water supply.

Justification:

Urbanization in the upper part of the basin has altered the hydrologic regime of Little Anderson Creek. The culvert which was adequately sized at installation is not longer able to handle peak flow events. As lead agency Kitsap County has the authority to deal with land use actions which are triggering hydrologic changes and causing impacts to public works and water supply. Interested parties will assist in the development of specific recommendations.

**PRESCRIPTION: HYDROLOGY ARS-4; UNIT 20
WEST KITSAP WAU**

WAU: West Kitsap

Resource Sensitivity Number: ARS MAP-4; Prescription Unit 20

Description: Entire West Kitsap Watershed Administrative Unit.

Situation Sentence for the Area (from causal mechanism report):

Increases in magnitude and duration of peak flow from past and potential future increases in overland flow in areas hydrologically connected to Geomorphic Units 1, 2, and 3 due to increases in impervious surface and direct delivery of water to streams increases bed mobility and bank erosion which scours spawning gravels and fills pools in Geomorphic Units 1, 2, and 3 (and accelerates incision in Geomorphic Units 1, 2, 3, and 5 limiting spawning and rearing habitat for chum, coho, steelhead, and/or cutthroat.

Triggering Mechanism (from causal mechanism report):

1. Reducing infiltration by constructing impermeable surfaces (e.g., paved roads, rooftops) or by soil compaction (e.g., lawns, unpaved roads, skid trails), particularly in areas adjacent to defined channels where water is routed quickly (and in some cases directly).
2. Road drainage networks which function as extensions to the natural channel network by capturing and routing water quickly down ditches and/or pipes to stream channels. This seepage face converting subsurface flow into ditch flow. This effect may be mitigated where road construction practices allow for re-infiltration of water, (e.g., outsloping, installing adequately sized, spaced, and maintained ditch relief culverts draining onto vegetated, uncompacted, planar and convex slopes, thereby significantly slowing routing times of storm runoff. In urbanized settings, stormwater detention may also provide some mitigation.

Rule Call for Management Prescription (from causal mechanism report):

Prevent and Avoid

Field Observations:

See Causal Mechanism Summary for Hydrology.

Management Objective:

Prevent and avoid increases in natural stream bed mobility and bank erosion (which scours spawning gravel/fills pools) caused by increases in overland water flow from impervious surfaces in geomorphic units 1, 2, 3, and 5.

PRESCRIPTION: HYDROLOGY ARS-4; UNIT 20
WEST KITSAP WAU

Prescriptions:

Roads:

1. Avoid forest road construction or reconstruction within 200 feet of defined stream channel.
2. If road construction or reconstruction is unavoidable, refer to Appendix C (Fully Engineered Road Definition) to reduce direct or increased water flow to stream channels.
3. Prior to approval of a forest practice all active and inactive roads associated with the forest practice require a detailed plan (refer to "Road Maintenance Plan Guidelines") mitigating direct or increased water flow to stream channels.
4. Landowners are encouraged to abandon roads that direct water into stream channels. Abandonment shall be in accordance with WAC 22-24-050 (5) and the abandonment section of the "Road Maintenance Guidelines" for the West Kitsap WAU.
5. For Forest Practices activities within 200 feet of any typed water or that have slopes greater than 45% which drain into Geomorphic Unit 1, 2, 3, 5, limit the extent of soil compaction from construction. Landings or skid trails shall be limited to a maximum of 10% of any forest practice permit.
- 6a. Avoid soil compaction from skid trails that will direct water flow to stream channels.
- OR
- 6b. Abandon landings, skid trails by uncompacting surface.
7. Skid trails should be water barred, as necessary, and reseeded with native grass species or reforested within one growing season.
8. If soil compaction from skid trails is unavoidable refer to "Surface Erosion Prescriptions" to mitigate direct water flow.

Justification for Prescriptions:

Impervious surfaces adjacent to stream channels may direct overland water flow into channel increasing natural rate of bed mobility and bank erosion.